D2.4
Irish Sea Pilot

Land-Sea Interactions Case Study Report

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Supporting implementation of maritime spatial planning in the Atlantic region

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1 Introduction

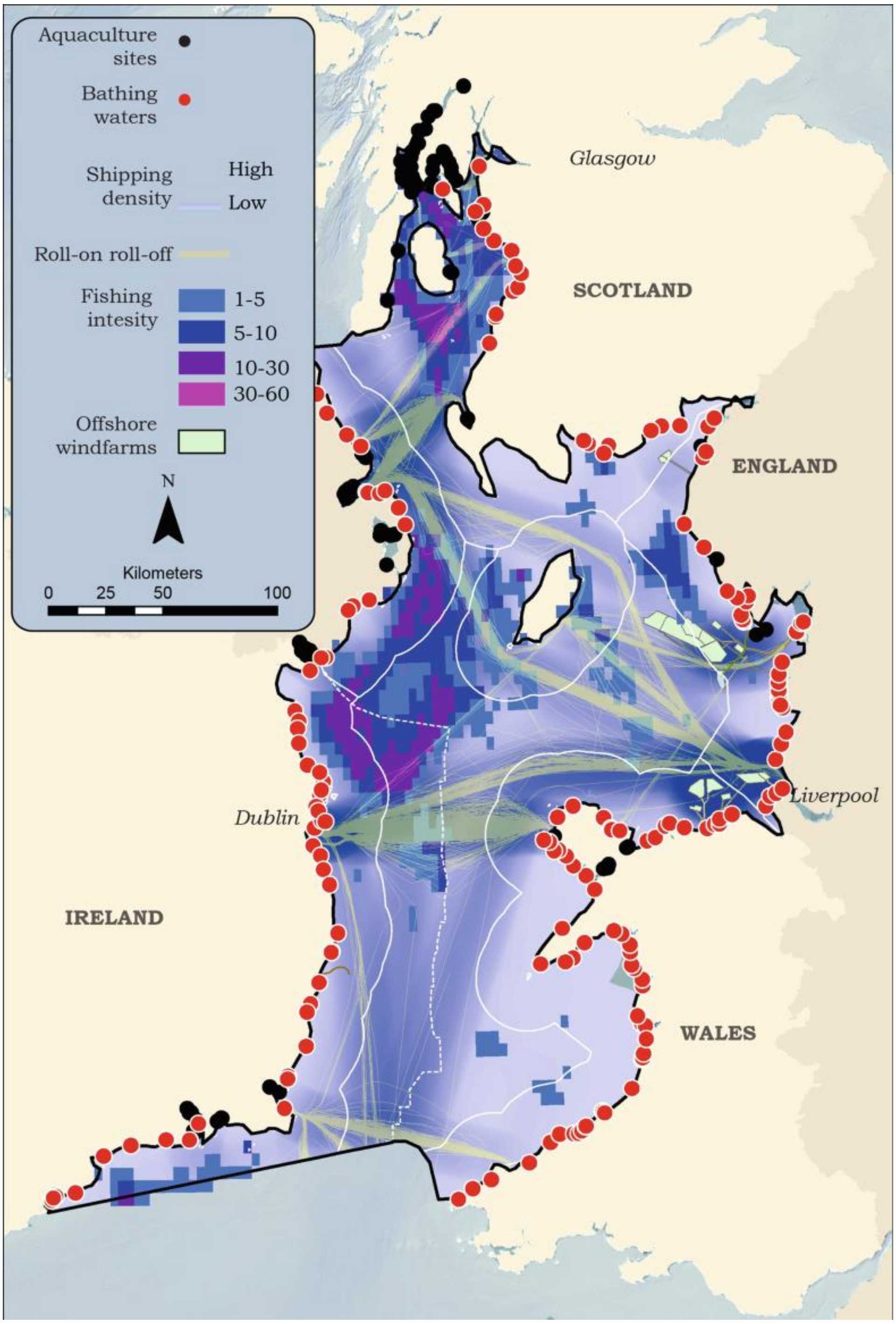
Article 6(2)(a) of the EU MSP Directive 2014/89/EU sets out as a minimum requirement that Land-Sea Interactions (LSI) should be taken into account when preparing maritime spatial plans. Box 1 provides more detailed information regarding this and other requirements. More information can be found in the SIMAtlantic report *Overview of MSP and LSI in the European Atlantic*. Many maritime activities and processes have an onshore impact with ramifications to the communities and environment that surround them. For example, shipping requires ports, which create employment opportunities and lead to prosperity in a region, whilst marine currents and storm systems can cause erosion, accretion or coastal flooding. The same can be said for activities which take place on land and affect the marine environment and marine ecosystems. These can include agricultural run-off, leading to eutrophication of marine and sea lough waters, or increases in transport and infrastructure increasing the viability of offshore industry. The dynamics between land and sea and between the environment, society and the economy can be both positive and negative, and careful consideration and planning are required. This can include the consideration of trade-offs, the use of the best available data and aligning with local, national, regional and international guidance.

Box 1: Minimum requirements of the MSP Directive 2014/89/EU

- Take into account **land-sea interactions**
- Take into account environmental, economic and social aspects, as well as safety aspects
- Aim to promote coherence between maritime spatial planning and the resulting plan or plans and other processes, such as integrated coastal management or equivalent formal or informal practices
- Ensure the involvement of stakeholders
- Use of the best available data
- Ensure transboundary communication between member states
- Promote cooperation with third countries
- Maritime spatial plans shall be reviewed by member states as decided by them but at least every 10 years

Whilst the requirements of the MSP Directive are a key consideration of the work that has been undertaken, national government requirements that relate to LSI, economic and development plans and other environmental and infrastructure legislation also need to be considered.

This report presents the methodologies and results from two sub-case studies which form the Irish Sea Pilot and were undertaken as part of the SIMAtlantic project. The tools used to address LSI in these two studies are very different in their approach and aim to highlight how, when investigating LSI, one of the first things to be taken into consideration is what is the best approach to address a particular LSI issue or opportunity.

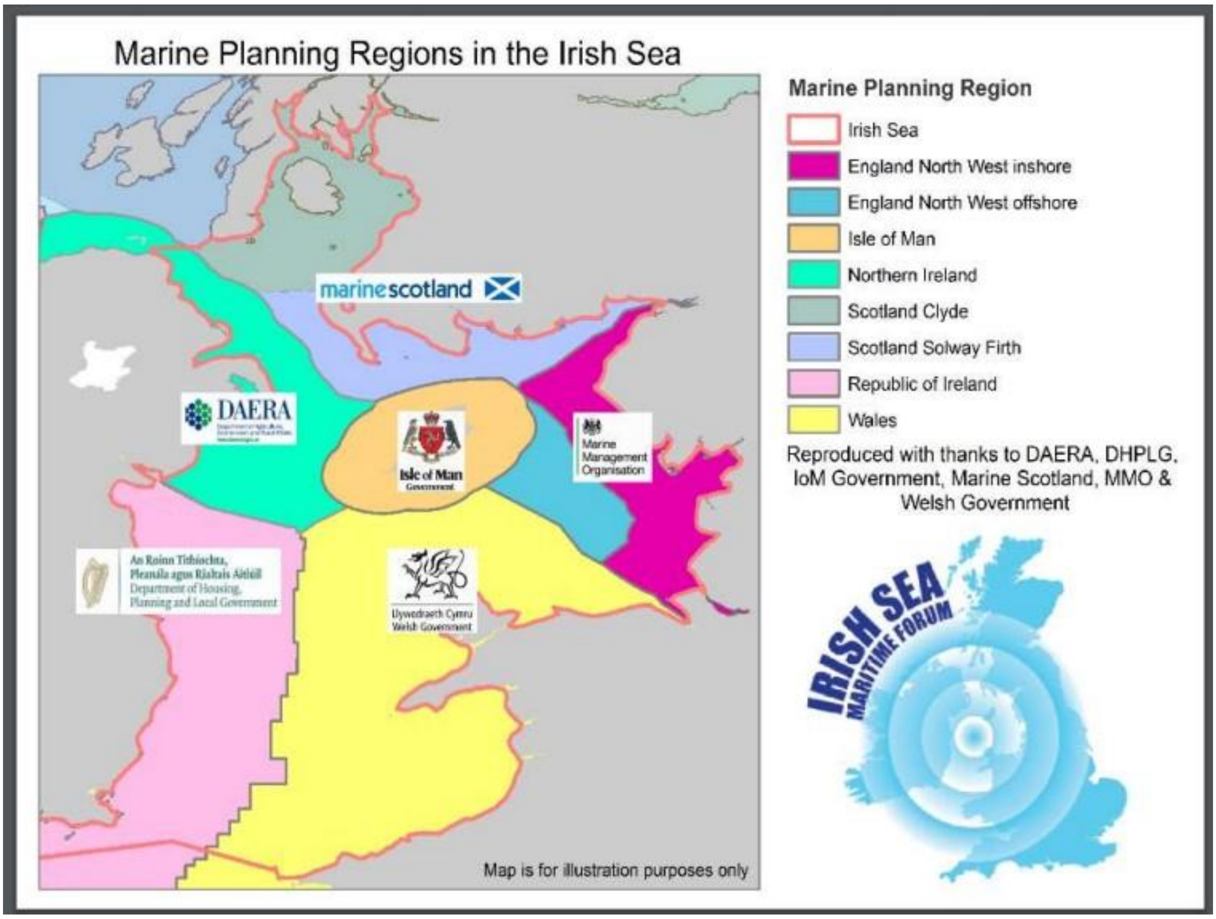


Map 1: Map of Sectors addressed in the MSP Directive in the Irish Sea. Source: O'Higgins T., O'Higgins L., O'Hagan A.M., Ansong J.O. (2019) Challenges and Opportunities for Ecosystem-Based Management and Marine Spatial Planning in the Irish Sea. In: Zaucha J., Gee K. (eds) Maritime Spatial Planning. Palgrave Macmillan

Map 1 shows the extent of the Irish Sea; the pilot studies covered Irish and Northern Irish waters, though the effects of the activities within these areas may extend to other waters or the terrestrial environment in any of the Irish Sea countries. Some of the key sectors and activities which take place in the Irish Sea are also shown on this map, including shipping, aquaculture, fisheries, offshore wind and bathing areas that are important for tourism.

2 Background to the Irish Sea Pilot

The purpose of the Irish Sea Pilot and the information contained within this report is to test two very different tools to investigate LSI and their use both within the Irish Sea and their replicability within the SIMAtlantic Project region and beyond. The Irish Sea Pilot covers Irish and Northern Irish waters and are highlighted in pink and green in Map 2.



Map 2: Marine Planning Regions in the Irish Sea. Source: Ritchie & McElduff, University of Ulster.

As can be seen in Map 2, the area covered by the Pilot borders a number of other marine planning areas, including the Welsh marine plan area, the waters of the Isle of Man, England's north west plan areas and the Scottish marine regions of the Clyde and Solway Firth. The limits of Irish Sea according to the International Hydrographic Organisation are: to the north, the southern limits of the Scottish Seas around the Straits of Moyle; and to the south, via St George's Channel in a line from St David's Point in Wales, through Skomar Island and the Smalls to Carnsore Point in Ireland. The Irish Sea covers a total surface area of 47,000 km2 (18,000 sq mi).

The Irish Sea and the coastline and land which surround it are home to a host of wide-ranging activities. Within the sea itself, recreational activities such as recreational fishing, diving, sailing all take place from hubs around the coast. There has been in recent years a drive towards eco-tourism in many coastal areas around the Irish Sea, particularly in Wales, Ireland and the Isle of Man (which is a designated UNESCO biosphere reserve). Eco-tourism was highlighted as a key development opportunity sector and in the *Future and Changing Contexts of the Irish Sea in the 2020's* (ISMF, 2021). Potentially competing with these activities, which require healthy, sustainable ecosystems, are a number of economic activities on land and at sea. Cruise tourism in the Irish Sea has also seen growth in recent years due to the large ports of Belfast, Dublin and Liverpool, which also requires significant infrastructure and investment on land. Shipping and Short Sea Shipping is also prominent around the Irish Sea.

The fisheries industry in the Irish Sea has a long history, and has seen many changes over the years due to competition with other activities for space and environmental changes and declining stocks. The majority of fishing vessels in Irish Sea waters at present fish for the Dublin Bay prawn *Nephrops norvegicus* which has managed to maintain sustainable stock levels since the 1970's (NIEA, 2015). Lesser quantities of cod *Gadus morhua*, haddock *Merlanogrammus aeglfinus*, herring *Clupea harengus,* plaice *Pleuronectes platessa,* sole *Solea solea,* and whiting *Merlangius merlangus.* The majority of fishing in the Irish Sea takes place in the North West quarter (Salthouse, 2021), off the coast of Dublin up to the mouth of Carlingford Lough and into Northern Irish waters off the coast of Newcastle, as can be seen in Map 1.

The Irish Sea has historically had a relatively longstanding history of oil and gas exploration, though none currently takes place within the Irish Sea Pilot project area. There are however fields with production still in operation in adjacent waters under the jurisdiction of other planning authorities. These activities may have environmental impacts on the project area, or present opportunities should diversification of use take place following decommissioning. There are existing and historical nuclear power sites along the coast of the Irish Sea, although none within the Irish Sea Pilot area. Currently Heysham 1 & 2 near Morecambe on the English coast are operational, and the Sellafield site which housed a power plant is still a major site for nuclear decommissioning and the largest nuclear site in Europe. This has led to some claims that the Irish Sea was the most radioactive sea in the world in the 1990's (Irish Times, 1998), although changes in processes at the site have led to much improvement in recent years. Most historical radioactive contamination seems to be confined to the Irish Sea Mudpatch in the eastern Irish Sea, which acts as a buffer (Ray et al, 2020). Most terrestrial originated pollution enters the Irish Sea via the riverine and estuarine system from industrial activity and agricultural run-off.

3 Case Study 1 – Land-Sea Interactions and the Effects of Climate Change on Shellfish Aquaculture in the Irish Sea

The first of the two case studies looks at the LSI, and specifically how the effects of climate change can influence them and the subsequent impacts these may have, on shellfish aquaculture in the Irish Sea. This sector was chosen for investigation following a series of meetings with the project's LSI Working Group led by the University of Liverpool, and included the marine planning authorities for Ireland (Department of Housing, Local Government and Heritage (DHLGH)) and Northern Ireland (Department of Agriculture, Environment and Rural Affairs (DAERA)), the Agri-food and Biosciences Institute (AFBI) based in Northern Ireland, and University College Cork. A scoping exercise was conducted and an investigation into the aquaculture industry (specifically shellfish) was decided upon based on a number of criteria stipulated by the marine planning authorities within the Pilot area, namely that there is a transboundary context to the sector, and that the sector was of key interest to both marine planning authorities and also other governmental high level strategic objectives.

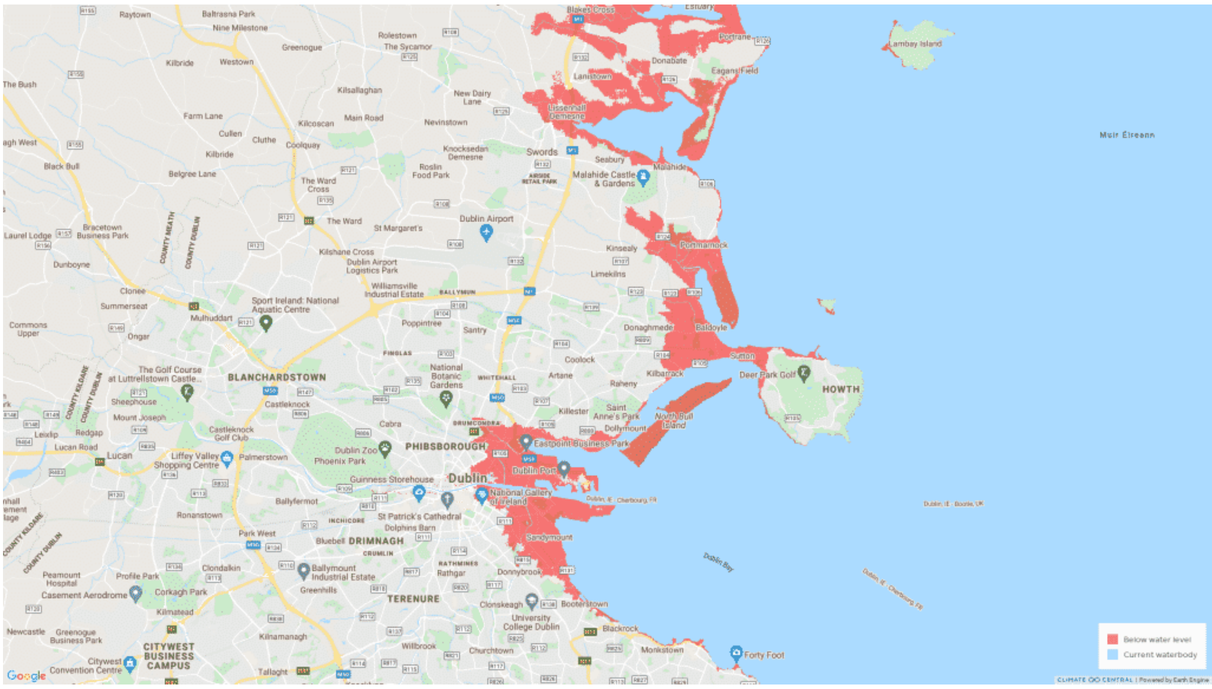
3.1 Background information relating to the shellfish aquaculture sector in the case study area

As part of the European and global trend towards industries related to blue growth, aquaculture is fundamental to strategies in both Ireland and Northern Ireland. The shellfish aquaculture industry is expected to grow over the coming years, allowing for economic growth, increases in employment opportunities, and providing a food source which is more sustainable than traditional land-based cattle farming in terms of space utilisation and greenhouse gas emissions. In Northern Ireland, according to the *Draft National Marine Plan*, the shellfish aquaculture industry produced 3,428 tonnes of shellfish at a value of £4.3 million in 2016, maintaining these approximate levels through to 2018. In Ireland, the shellfish aquaculture industry holds more economic value; according to the Irish Fisheries Board - *Bord Iascaigh Mhara* (BIM), this equated to 21,200 tonnes with a value of around €60 million in 2019. These figures however fell to 19,600 tonnes with a value of €44 million in 2020 largely due to the impacts on the industry caused by the global pandemic and its effect on the hospitality industry worldwide (BIM, 2021). The potential for growth within the aquaculture sector in general in Ireland has long been recognised, including in Ireland's *Integrated Marine Plan; Harnessing Our Ocean Wealth* (HOOW) which was published in 2012, albeit with some recognition that barriers to the growth of the sector existed. One of the key enabling actions of the Integrated Maritime Plan that was identified was the production of a *National Marine Research and Innovation Strategy* which itself was published in 2017. This identifies aquaculture and biomass product (MRIS) as a key component of the bioresources research theme and seeks to examine some of the barriers addressed in HOOW (2012).

The main species farmed via aquaculture in Ireland, according to BIM, are Irish Rock Oysters, also known as Pacific Oysters (*Crassostrea gigas),* and mussels (*Mytilus edulis*), along with smaller quantities of other local shellfish such as native oysters (*Ostrea edulis)* and clams. Similar species are cultivated in Northern Ireland, although on a somewhat smaller scale than in the Republic. Due to the rapid growth of the shellfish aquaculture sector in both countries over the past couple of decades, a number of research projects have been carried out. One of the most comprehensive projects to date was the *Sustainable Mariculture in northern Irish sea Lough Ecosystems* (SMILE) project which was brought about following a review of shellfish aquaculture in Northern Ireland undertaken by AFBI in 2001. The project examined five sea loughs in Northern Irish waters, 5 of which fall within the Irish Sea Pilot area, namely Belfast, Larne, Carlingford and Strangford. Lough Foyle is another transboundary sea lough on the northwest border with the Republic of Ireland and also presents some interesting challenges for the sector on the island of Ireland, particularly in relation to governance, licensing and monitoring, and as such has also been taken into consideration in the recommendations outlined later in this report. The SMILE project had four key objectives, namely: to establish functional models and describe the key environmental variables and processes and their interactions with aquaculture activities; to evaluate a sustainable carrying capacity in each of the sea loughs; to examine the effects of over exploitation on key ecological variables; and to examine bay-scale environmental effects of different culture strategies. These four objectives provide the foundation for the creation of a series of baselines which are of key importance for the sustainable management of aquaculture in Northern Irish sea loughs and as such have been used in monitoring activities which occurred in follow on projects and official monitoring programmes. Furthermore, the tools described and utilised as part of the project are replicable for use in other sea loughs within the SIMAtlantic Project Area where aquaculture takes place.

A second key variable which is taken into consideration within this case study is the potential impact that climate change can have on shellfish aquaculture, and, more crucially, how LSI could play a part in either mitigating or exacerbating any potential change to the ecosystems which allow for sustainable shellfish aquaculture. The aquaculture industry as previously highlighted is a key sector and vital to the island of Ireland as a whole. Climate change has the potential to have massive impacts on the industry in a number of ways which have been investigated by a number of studies in recent years. Increased temperature can result in a shift in suitable sites for aquaculture farm location and increased threat from invasive or non-native species. A recent IPCC report highlighted various areas along Ireland’s coastline which could be under serious threat from rising sea level over the next decade and beyond, stating that immediate intervention is required. Areas around Belfast and Dublin within the Irish Sea Pilot area were noted as areas under threat. A number of maps have been produced by Climate Central, a non-profit organisation, which identify key at-risk areas, such as those shown in Map 3.

Acidification of marine water due to increased anthropogenic atmospheric CO2 uptake can have serious impacts on marine life, particularly shellfish species, by affecting the calcification or ‘shell forming’ process necessary for species such as mussels or oysters (Maulu et al. 2021). While these changes would happen over time, usually a matter of decades, a gradual decrease in production or quality of harvest could be anticipated if mitigating actions were not taken, or if there was not a shift to a species with a greater adaptive capacity for the changing conditions. While it is understood that often predictive adaptive capacity in developing countries can often be found to be low due to governance related issues, in developed countries and within the Pilot Area this can be due to low species diversity (Stewart-Sinclair, P.J. et al 2020).



Map 3: At-risk areas around Dublin Source: Climate Central. https://coastal.climatecentral.org/

A review of climate change impacts to marine aquaculture specific to the UK and Ireland published in 2012 by Calloway et al identified rapid sea level rise, particularly towards the end of the century, and increases in storm damage in the North East Atlantic, of which there has already been an increase seen over the past 50 years. Storm damage is a major threat to the aquaculture industry, in particular to some of the most common species cultivated in the Irish Sea including mussels *(Mytilus edulis)* whose cultivation can be directly damaged. Storms can also impact the wider industry more generally through damage to infrastructure and processes sites, which are usually located in close proximity to the coast. Increased rainfall, another predicted consequence of climate change, could result in increased run-off from land. This additional discharge into the marine system could bring with it excess sediment, pathogens and nutrients which could lead to a wide range of issues, all of which could affect aquaculture. According to Calloway et al, 2012, some of the most damaging and least predictable effects of climate change relate to the emergence, translocation and virulence of diseases, parasites and pathogens. A major reason for this is that increased external stressors relating to climate change, such as acidification, changes in salinity and change in sea temperature, can push species to the edge of their tolerance ranges, leaving them immuno-compromised and susceptible to disease. Increased storm events are also anticipated to facilitate disease outbreaks in the future. The shallow estuarine environments found on the Irish Sea coastline within the Pilot area are more readily sensitive to climate change than the open ocean leaving them vulnerable to microbiological pathogens such as marine vibrios, a genus of thermo-dependent bacteria which would thrive in warmer, lower salinity waters (Stewart & Elliot 2015).

3.2 Governance relating to the shellfish aquaculture industry in the case study area

Governance of the aquaculture industry on the island of Ireland, for both the Republic of Ireland and Northern Ireland, are subject to local, national and international laws and agreements and, in the case of the Republic, various articles within European legislation. While many of these apply to both countries there are of course significant differences at the national and local levels and following the UK exit from the European Union, scope for further differences at a European level in the future.

One piece of legislation which provides for aquaculture is the Oslo-Paris (OSPAR) Convention. Article 2 of the 1992 OSPAR Convention requires, in accordance with the provisions of the Convention, all possible steps to be taken to prevent and eliminate pollution, either from land-based sources or through direct inputs into the marine environment, and to protect the maritime area against the adverse effects of human activities so as to safeguard human health and to conserve marine ecosystems. To this end, contracting Parties, including Ireland and Northern Ireland (as part of the UK) shall, individually and jointly, adopt programmes and measures and shall harmonise their policies and strategies. As the wording of the Convention includes in Annex 1 "sources associated with man-made structures placed in the maritime area under the jurisdiction of a Contracting Party, other than for the purpose of offshore activities" under the definition of "land-based sources" mariculture is covered within these obligations.

The key current recommendation of relevance to the Irish Sea Pilot is the Paris Convention (PARCOM) Recommendation 94/6 on Best Environmental Practice (BEP) for the Reduction of Inputs of Potentially Toxic Chemicals from Aquaculture Use. There are also concerns relating to eutrophication although these are predominantly focused on fin-fish aquaculture and therefore beyond the scope of this case study. Impacts on biodiversity and ecosystems are also taken into consideration in Annex V of the Convention via the examination that the 'non-polluting' activities can have on habitats, ecosystems and biodiversity; the siting of aquaculture / mariculture sites is of particular relevance in this regard. OSPAR guidance on mariculture notes the difficulty in the control of non-indigenous species within the area covered by the convention due to the wide-ranging management methods in place locally and regionally (OSPAR, 2006). Additionally, the importance of such non-native species including the Pacific Oyster, a key shellfish species cultivated within the Irish Pilot project area and other locations within the SIMAtlantic area, need to be taken into consideration. The diversity and site specificity of the industry as a whole is recognised by the Commission and as such is reflected in its guidance to contracted parties; however, no firm measures have been implemented by OSPAR to date.

In addition, Ireland and the United Kingdom, as well as all other countries included in the SIMAtlantic project, are ratified members of the International Convention on Biological Diversity (CBD, 1992). The CBD is a multilateral treaty which aims to conserve biological diversity, promote the sustainable use of the components of biological diversity and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. The CBD highlights that biodiversity underpins a successful and sustainable aquaculture industry and promotes the use of integrated marine and coastal area management as a framework to address human impacts on biological diversity (COP 2 Decision II/10). The definitions for many of the concepts outlined in the CBD are those adhered to in other legislation, including those of the OSPAR Convention discussed above. The CBD led to the production of the *Strategic Plan for Biodiversity 2011-2020*, which included in its 2010 revision a series of targets relating to biodiversity known as the Aichi targets, 20 targets relating to five strategic goals outlined within the plan. Under Strategic Goal B, to “reduce the direct pressures on biodiversity and promote sustainable use”, target 7 states that “by 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity”. Unfortunately, despite the wide and high level of support for the CBD, the majority of the 20 Aichi targets outlined were not met by the 2020 deadline (Nature, 2020).

3.3 Designing the BT SWIFT methodology

Following initial consultation with the SIMAtlantic Working Group it was decided that a more environmentally-focussed approach to examining LSI should be taken for one of the two case studies which form the Irish Sea Pilot. Climate change was seen to be one of the biggest threats to economic sectors based on or near the coast, and the societal implications of that also could have far-reaching effects. Offshore shellfish aquaculture along the coastline is an expanding industry in both Ireland and Northern Ireland, and the LSI implications of this industry have a strong transboundary component and will require significant cooperation to be effectively addressed. The work undertaken as part of two EU-funded projects; the EU PF7 Devotes Project which aimed to better understand the relationships between pressures from anthropogenic activities and climatic influence and the H2020 CERES Project which investigated how climate change is affecting different European fish/shellfish species (CERES, 2020). The bow-tie analysis technique was chosen by the LSI Working Group to be examined from an LSI perspective for its climate change-oriented outlook and risk analysis-based origins.

Having originated for use in the petrochemical industry, and most well-known for use in the oil, gas and sectors, the bow-tie risk evaluation method is commonly used to analyse and highlight causal relationships in high risk scenarios (CGE Risk, 2021). The name of the technique comes from the unique shape of the diagram which is usually created an example of which is shown in Figure 1.

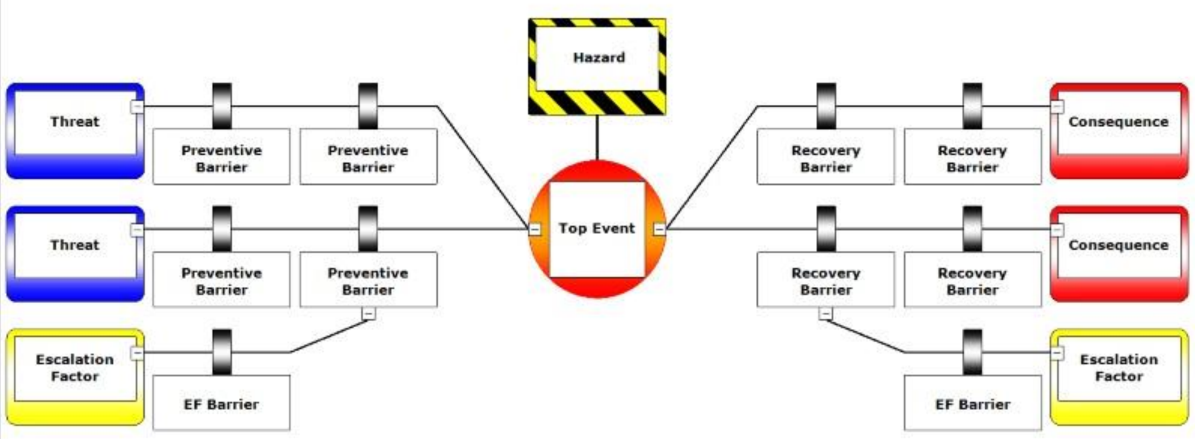


Figure 1. An example of a bow-tie diagram. Source: CGE Risk. 2021.

Using the bow-tie method, a visual representation can be given of scenarios relating to a particular identified hazard. The first step in the process is to identify what is commonly called a Top Event; this is the tipping point at which the hazard takes control of the situation or activity being undertaken. The key consideration for this is that it is to a degree subjective, and as such expert judgement is required to ensure that the most appropriate point, or environmental criterion, is chosen. For example, for shellfish aquaculture, this could be drops in larval growth rates or shift in habitable zone for a particular species. The next stage in this process is to identify potential threats which can bring about the top event and then subsequently identify barriers to these risks or, in the terminology used in the SIMAtlantic methodology, these are known as control measures. Once a particular threat has resulted in a top event, attention should turn to potential consequences; what happens when the tipping point of a hazard has been exceeded. For shellfish aquaculture, an example of where loss of viability for a particular species is the top event or key problem could be industry job losses or increased pressure on alternative species. In order to attempt to address these consequences, it is recommended that a further layer of recovery barriers or mitigation strategies is put in place in order to manage the overall risk to the system. Examples of such measures could be legislative measures put in place to control environmental and other impacts, or habitat restoration initiatives. The final consideration as part of a standard bow-tie analysis exercise is the impact of escalation factors which essentially describe ways in which a control and mitigation strategies may fail. From a MSP perspective, these often relate to changes in governance related to the system being examined, or economic or infrastructure-related policies which can change over time, for example with a change of government or wider EU guidance.

In order to effectively use a bow-tie risk evaluation methodology in an LSI / MSP context, the DEVOTES and later CERES work used this previously industry standard process with in an ecological context. Using an expanded version of the well-established DPSIR (Driver-Pressure-State-Impact-Response), an approach known as DAPSI(W)R(M) was developed in which Drivers of basic human needs require Activities which lead to Pressures. The Pressures are the mechanisms of State change on the natural system which then leads to Impacts (on human Welfare). Those then require Responses (as Measures) (Elliot et al. 2017). One of the major drawbacks of the DPSIR framework is that it tends to focus on individual environmental pressures, rather than the suite of pressures which would be placed upon a system as a result of a highly complex issue such as climate change (Elliot & O'Higgins. 2020). In moving to the DAPSI(W)R(M) approach, Elliot & O'Higgins describe the new approach as a "Butterfly" model, more holistic and more fully encompassing of the socio-economic and ecological aspects of ecosystem services (Figure 2).

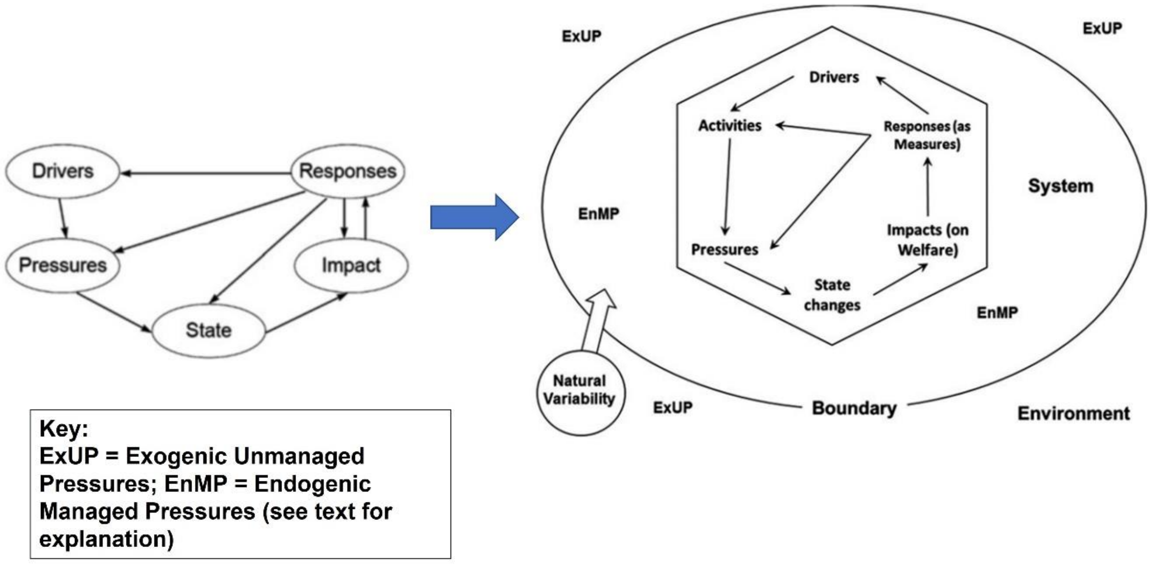


Figure 2: The Evolution of DPSIR to DAPSI(W)R(M). Source: Adapted from EEA (1999) and Elliot et al (2017)

Another key benefit of the DAPSI(W)R(M) framework is its focus on the marine environment and ecosystems specifically. It has been developed so as to remove the ambiguity which exists when using the DPSIR framework in this context. The DAPSI(W)R(M) framework also addresses a fundamental need which had been discussed in academic literature for some time, which is to separate in some way Drivers from Activities and also Activities from Pressures, thus allowing an Ecosystem Based Management approach, as required by multiple pieces of EU and national legislation to be undertaken effectively. In addition, Pressures within the new framework have been separated out into pressures affecting a given sea area into Exogenic Unmanaged Pressures (ExUP) and Endogenic Managed Pressures (EnMP). Exogenic Unmanaged Pressures emanate outside the area, such as sea-level rise as the result of global climate change, so management within the area under consideration in this instance is only treating the consequences of such a pressure. Endogenic Managed Pressures occur within the management area, so both their causes and consequences need to be managed. The framework also notably reflects not just the State of the ecosystem, but also the State Change of the ecosystem as a direct result of the anthropogenic pressures placed upon it. Finally, the Impact (on Human Welfare) is reflected in this framework which takes into consideration the monetarily quantifiable Ecosystem Services often overlooked from an environmental accounting perspective. Responses within this framework can be placed upon any other element, rather than the more linear approaches suggested in the past providing a more dynamic outlook which is much more adaptable and resilient from a change management perspective.

The work described as a direct result of the CERES Project was able to underpin the bow-tie risk management structure within the DAPSI(W)R(M) framework as shown in Figure 3.

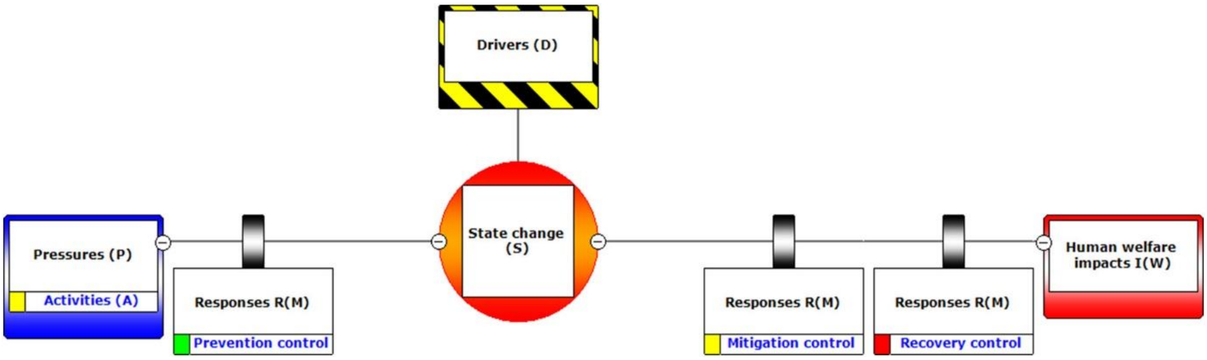


Figure 3: The bow-tie structure of DAPSI(W)R(M). Source: Cormier et al. 2019

This DAPSI(W)R(M) aligns well with the frameworks which have been discussed earlier in this report to address LSI. The next stage within the SIMAtlantic case study was to assess the desire of MSP authorities to engage with such a rigorous risk management process. In order to do this, separate non-directed interviews were conducted with a number of MSP authorities within and surrounding the case study area in order to discuss the feasibility of using such an approach to manage climate change-related LSIs within their jurisdiction. Whilst the approach was met with much positivity from all of the authorities, the feasibility of conducting such an in depth investigation was deemed overall to be unfeasible to be undertaken in a day-to-day scenario with regard to MSP.

The SIMAtlantic LSI Working Group then sought a methodology that still fits the requirement of being robust from an industry stand-point whilst also working within their time and personnel constraints. Another risk identification technique, with its origins in industry, this time, the chemical industry, is the Structured What-If Checklist Technique (SWIFT). The methodology used a hybrid of the bow-tie technique and SWIFT, essentially using a bow-tie tailored by colleagues at AFBI (Figure 4), considered experts in the field of shellfish aquaculture ecosystems specific to Irish sea loughs. This bow-tie was then used as a checklist to form and advise discussions at two online workshops. These workshops were attended by expert stakeholders, from MSP and other authorities, scientific bodies and industry representatives.

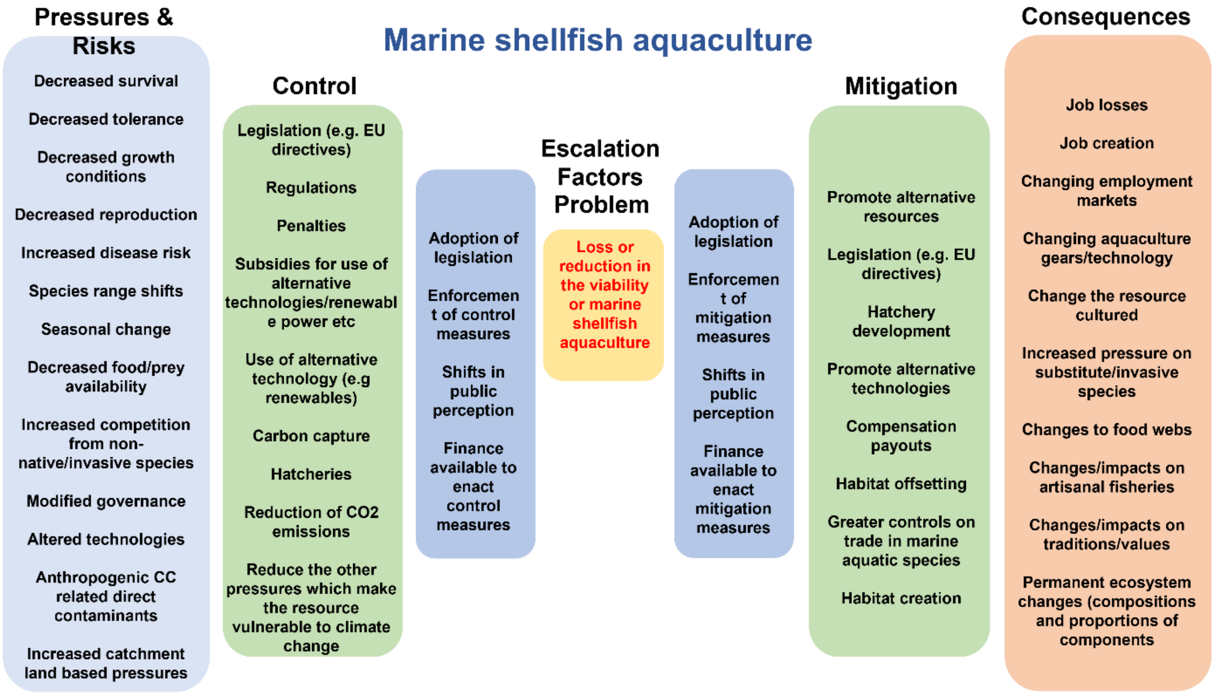


Figure 4: The Marine Shellfish Aquaculture Bow-tie for the island of Ireland (adapted from CERES Project 2019)

3.4 Stakeholder participation and engagement

From the very inception of the Irish Sea Pilot, it was agreed with the LSI Working Group that the impact of climate change related LSI on shellfish aquaculture should have a very strong stakeholder engagement component. Originally this aspect of the work was planned to be conducted face-to-face during the week of the 2020 European Maritime Day events which were due to be held in Cork in May of that months. Unfortunately, the Covid-19 pandemic situation at that time meant that this workshop along with numerous others had to be cancelled. This presented a significant challenge to this aspect of the work. In order to obtain the most meaningful amount of data from stakeholders directly involved in the shellfish aquaculture sector, impacted stakeholders and policy makers a new approach was derived.

Due to the unknown length of time the various national lockdowns would be kept in place, it was decided that rather than one in person workshop facilitated by approximately five members of the LSI Working Group, and more open to members of the wider community and anticipated to have approximately 60 people in attendance, two much smaller online workshops attended by invited only key stakeholders would serve as a replacement. Each workshop had 10 participants (including the facilitator) in attendance, based on recommendations for conducting a SWIFT style approach this is the upper limit for the number attendees for this type of session. The decision to include 10 people per session rather than the recommended 4 to 8 people was based on the need to include a good mixture of planners, government body representatives, the scientific community and industry representatives. Prior to each workshop, each participant was sent a copy of the bow-tie in an excel format, similar to that which would be used in a standard SWIFT facilitation workshop and ask to complete this and return to the organisers in advance of the workshop (Figure 5). This allowed organisers and facilitators to identify priority areas for discussion during the workshops. Participants were asked to select up to two consequences and safeguards from dropdown lists derived from the original bow-tie. In addition, participants were given the option to add new consequences and safeguards for wider discussion at the workshops.

What If (Pressures & Risks)	Consequences (1)	Consequences (2)	Consequences (New)	Safeguards (Control/Mitigation)	Safeguards (Control/Mitigation) (2)	Safeguards (Control/Mitigation) (New)	Recommendations
Decreased survival (1,2,5,7,9)							
Decreased tolerance (1,2,5,6,9)							
Decreased growth conditions (1,2,5,7,9)							
Decreased reproduction (1,2,5,7,9)							
Increased disease risk (1,2,5,6,9)							
Species range shifts (1,2,3,7,9)							
Seasons change (1,2,3,7,9)							
Decreased food/prey availability (1,2,3,4,5,6,7,8,9)							
Increased competition from non native and invasive species, introduction of non natives (1,2,3,6,7,8,9)							
Modified governance (5)							
Altered technologies (5)							
Anthropogenic CC related direct contaminants (5)							
pressures							

- Job losses (3,4,6)
- Job creation (3,4,6)
- Changing employment markets (3,4,6,7)
- Changing aquaculture gears/technology (1,2,3,4,6,7,8)
- Change the resource cultured (1,2,3,9)
- Increased pressure on substitute/alternative species (1,8, [illegible]
- Changes to food webs (1)
- Human hunger (3,4,5,6,8,9)

Figure 5. The BT-SWIFT Completion template. Source: SIMAtlantic Project

Each of the thirteen pressures and risks identified in the original expert-derived bow-tie were discussed during one of the two workshops conducted, followed by discussions on recommendations that could be utilised in a marine planning context to secure the viability of the shellfish aquaculture industry in a sustainable manner.

3.5 Case study results

Both the completed pre-workshop BT-SWIFT spreadsheets and transcripts from the workshops were analysed. From the pre-workshop speadsheets, the most agreed upon consequences and potential safeguards were identified and these were then discussed in greater detail during the workshop sessions. Table 1 highlights the results of these findings.

The major consequence to the industry from pressures and risks relating to specific species such as decreased survival, growth, reproduction, tolerance and increased risk of disease were agreed by the majority of participants to be centred around the economic and societal impacts relating to job losses within the sector and the knock on effects that would have on the communities that are based around this industry many of which have already had to diversify in the past from small scale fishing industry. Again, as can be seen from the table above similarities exist between the thoughts of the participants on the safeguards that should be used to mitigate and control these pressures and risks with the promotion of alternative technologies such as newer and improved cages (e.g. the OysterGro) for oyster farms which increase the survival rates and subsidies for alternative technologies/alternative power for some of the more energy intensive options, being a common theme. One notable exception is the focus on hatchery development should a decrease in reproduction rates for certain species be identified. This is of particular relevance to Pacific Oyster farms which are in themselves not native to Ireland and rely heavily on imports of spat, predominantly from France (Fox et al. 2020).

Table 1. Pressure/ Risk and key consequence/safeguard matrix for the effects on marine shellfish aquaculture in the Irish Sea . Source: SIMAtlantic Project.

What-If (Pressures / Risks)	Key Consequence	Key Safeguard
Decreased survival	Job losses	Promote alternative technologies
Decreased tolerance	Job losses	Promote alternative technologies Subsidies for the use of alternative technology/renewable energy
Decreased growth conditions	Job losses Increased pressure on substitute/alternative species	Promote alternative technologies Subsidies for the use of alternative technology/renewable energy
Decreased reproduction	Job losses Changes to food webs	Hatchery development
Increased disease risk	Increased pressure on substitute/alternative resources Job losses	Greater controls on marine aquatic species
Species range shifts	Change the resource cultured	Promote alternative resources
Seasons change	Permanent ecosystem changes (composition and proportions of components)	Promote alternative resources
Decreased food/prey availability	Changes to food webs	Reduction of CO2 emissions Reduce the other pressures which make the resource more vulnerable to climate change
Increased competition from non native and invasive species, introduction of non natives	Changes to food webs	Greater controls on trade in marine aquatic species Reduce the other pressures which make the resource more vulnerable to climate change
Modified governance	Changing aquaculture gears/technology	Promote alternative technologies
Altered technologies	Changing aquaculture gears/technology	Promote alternative technology
Anthropogenic CC related direct contaminants	Changes to food webs	Legislative directives
Increased catchment land-based pressures	Changes to food webs Job losses	Legislative directives

Increased disease risk threatening stocks can have economic and ecological consequences, with losses to populations potentially leading to job losses particularly for those on short term or temporary contracts and ecological if increased pressure is placed upon other substitute resources to make up the shortfall if one particular species is affected. The most important control or mitigation measure for this particular risk was identified as greater control on marine aquatic species. This could include controls on the sale of invasive species, for example to aquariums and greater checks for species within ballast water from international seafaring vessels in these areas. Decreased in prey or food availability is mostly likely thought to have significant impact on food webs within the ecosystem. General management of anthropogenic climate change by reducing CO2 emissions in order to slow down the rate of climate change and also reducing the other pressures which increase species vulnerability such as increased sediment influx, or eutrophication.

Another key pressure to the aquaculture industry is changing environmental conditions such as water temperature or salinity resulting in changes in the ranges where certain species can thrive the most commonly agreed-upon consequence of which would be a change in the resource (species) to be cultured for the industry to survive. It is important to note that this would not be a straightforward exercise and would likely require changes in the technology required and therefore significant investment and promotion of the new resource to existing markets which is the most common control/ mitigation method suggested. In a similar vein, the risk of seasons change, which refers to climatic changes such as milder winters, warmer summers, increased rainfall and therefore increased freshwater input to a system, or more frequent storm events, is thought to present the biggest threat which could result in permanent ecosystem changes. Depending on the severity of such changes without significant intervention this could result in the ecological collapse of an ecosystem. Considering the worst case projections of such changes, planning for a change in the resources which could be cultured in newer environmental conditions was the leading mitigation strategy which could be put in place to manage this risk.

Increased competition from invasive or non-native species is a common threat to traditional ecosystems and has already had significant impact on ecosystems within Irish sea loughs. This has already been seen following the introduction of one of the most commonly farmed species in the case study area, the Pacific Oyster is itself a non-native species and in fact was introduced in in 1960’s and became popular in the 1970’s and 1980’s to make up for a stock shortfall of the overfished native oyster *(Ostrea edulis)* and became a more popular resource for production due to its disease resistance and faster growth rates. Should significant environmental changes occur as a result of climate change in the future a decision may be made to move towards the cultivation of other non-native species once more. Any introduction of a new species either as a conscious economic decision or by accidental introduction will have significant impacts on food webs and the wider ecosystem and the services it can provide. Given the nature of these consequences greater controls on the import of species should be put into place. Rationale for this is already evident when looking at Lough Foyle, which has approximately 60,000 unlicensed trestles based on 2018 figures (Northern Ireland Assembly, 2021). Reducing other pressures which may negatively impact species currently cultivated may also reduce the risk of considering moving to an alternative resource at all.

The modification of governance can cover a number of high-level government policies which can ultimately influence the aquaculture industry and may relate as much to planning policy on land as at sea. High level policies relating to carbon emission reduction targets could have a positive impact on maintaining and improving existing ecosystems whilst changes to licencing decision making processes can streamline industry growth. The increase in the number of environmentally protected zones however could make industry expansion in certain area unviable. The major consequence of such pressures are thought to be focused on changes to the gears and technology used in the industry, perhaps involving a shift to more sustainable methods or examining options more suitable to co-existence of activities within marine areas. The promotion of such technologies, perhaps initially supported by subsistence mechanisms has been identified as a key mitigation strategy. Similarly, the introduction of new technologies needs to be monitored, to ensure the proper protection of existing natural ecosystems. Ensuring advances in technology promote a sustainable and ecosystem focused approach will be essential to maintain both the industry and the ecosystems which support it. Certain technologies may need to be promoted over others on the market.

While all of the pressures and risks outlined within the BT-SWIFT checklist have strong, but often indirect, land-based links, two pressures and risks are predominantly, but not exclusively, directly linked to activities on land. Both can cause distinct changes to food webs should a particular species be targeted and the follow-on effects. Both of these pressures require significant monitoring to effectively manage. Given the broad coverage of activities which could act as drivers for these pressures and their consequences, legislative measures are seen as the key mitigation strategy to address them.

3.6 Conclusions and future use of the tool

The combining of the bow-tie analysis technique and a Structured-What-If checklist style technique can make it possible to undertake a more rapid and less labour-intensive type study for use in future marine planning iterations. Adaptations to the methodology would be advised, based on feedback from stakeholders. The introduction of a ranking system for the importance of the pressures/risk would allow authorities to place greater resource at more expertly deemed critical points within the system.

Based on feedback from stakeholders the following steps have been identified to follow to utilise this technique in the future.

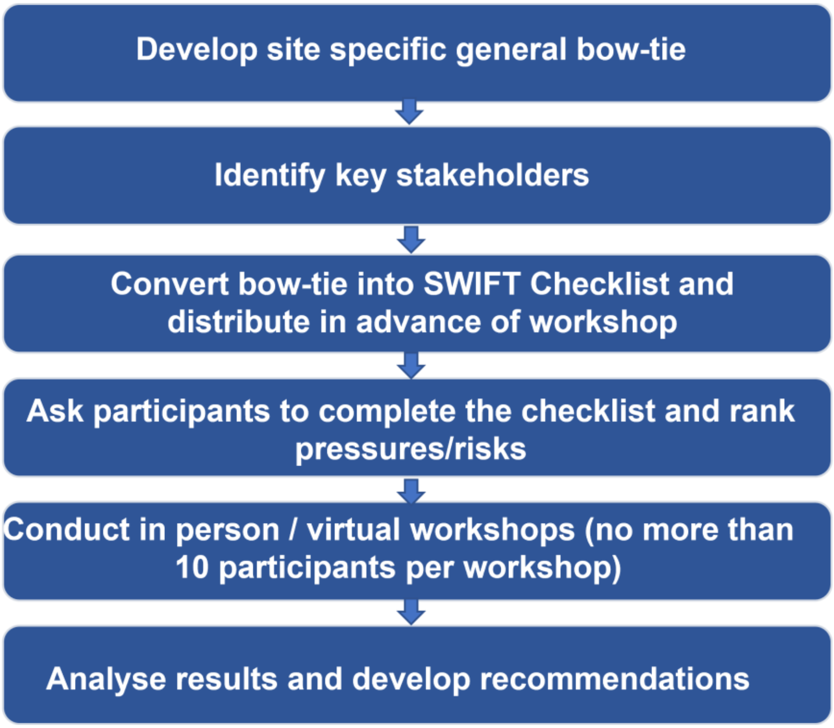


Figure 6: Recommended Steps for a BT-SWIFT Analysis. Source: SIMAtlantic 2021

4 Case Study 2 – Value Chain Analysis of Offshore Wind in the Irish Sea

The second case study which forms part of the Irish Sea Pilot examines offshore wind in the Irish Sea using an economic-based targeted value chain analysis technique which has been used in the earlier ESPON MSP-LSI Project (2018-2019). The value chain analysis technique explores how LSI can be defined and operationalised within an MSP process. This methodology uses a territorial based planning approach examining the impacts of a particular sector, both on land and on sea, building upon the 2013 World Trade Organisation publications. The project examined five case studies across different European sea basins; however none of these previous case studies fell within the SIMAtlantic Project Area. This case study aimed to apply the value chain methodology to examine the offshore wind sector within the Irish and Northern Irish waters of the Irish Sea. This will establish whether a value chain analysis can be suitably replicated within the project area. In addition, previous value chain analysis of offshore wind has taken place in areas where the industry is well established, with a number of operational wind arrays within the areas being examined. The situation in the Irish Sea is rather different with the offshore industry being very much in its infancy; however the potential for generation, import and export of renewable energy is massive. This value chain analysis will seek to establish where growth areas are in the Irish Sea and where the benefit of expansion of the industry will be most prevalent.

The value chain analysis methodology (Figure 7) which was utilised within the MSP-LSI Project has been adapted for use in this Irish Sea context. This process was followed throughout the course of this investigation to establish its suitability for a newly emerging sector in the Irish Sea. The following steps were followed as part of this process, with the exception of step 1 where the general value chain developed as part of the ESPON MSP-LSI was utilised. The approach the ESPON Project took started with adapting general sector value chains published for example by the WTO for use in Territorial Planning in order to highlight different segments of activity, envisage their spatial impact both with and beyond the pilot area.

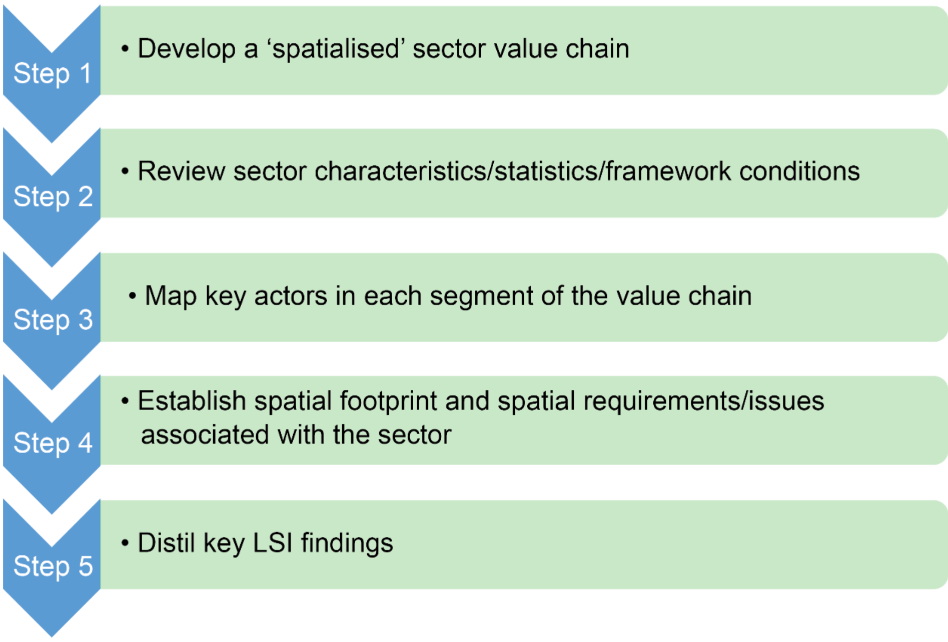


Figure 7: The Value Chain Analysis Steps. Source. ESPON 2020. MSP-LSI Project

The general value chain value chain for offshore wind created as part of the ESPON MSP-LSI Project can be seen in Figure 8.

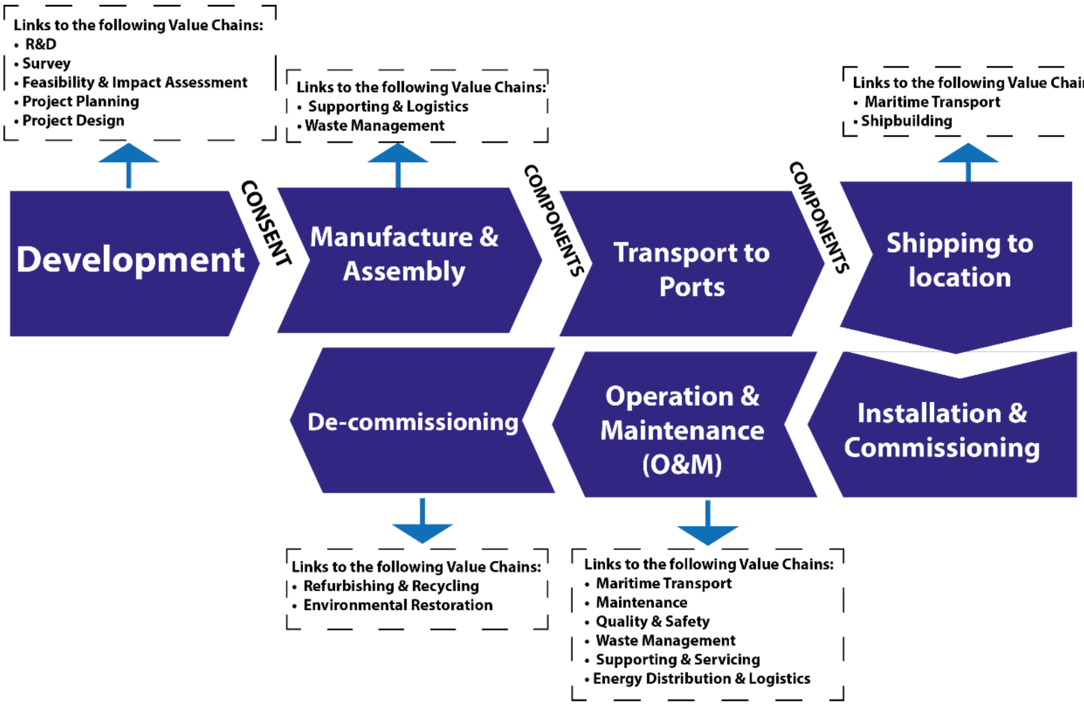


Figure 8: General value chain for Offshore Wind. Source: ESPON MSP-LSI Final Report 2020.

The general value chain for offshore wind was developed by the MSP-LSI Project to emphasize the land-sea dynamics of the individual value chain segments and also indicate links to other related value chains to ensure resource and support in these areas are considered. The general value chain for offshore wind also segmented in such as way as to best highlight distinct spatial differences between specific LSIs to allow them to be considered in an individual context. The individual segments of the value chain are as follows:

1) Development

2) Manufacturing & Assembling

3) Transport to ports

4) Shipping to location

5) Installation & Commissioning

6) Operation & Maintenance (O&M)

7) De-commissioning

4.1 Background information relating to offshore wind in the case study area

Offshore wind energy is the fastest growing Blue Economy sector in Europe and is of key strategic importance to numerous global strategies, including the European Commission Blue Economy Report which is reviewed yearly. Offshore wind is seen as key for delivering not only national but also European carbon emission reduction targets. In the European Commission's Annual Economic Report on the Blue Economy, renewable energy and offshore wind in particular was still regarded as an emerging but rapidly growing sector, in fact the fastest growing blue economy sector in Europe. According to the 2018 report, Offshore Wind in Europe had an operating capacity of 15.8 GW, with the UK being the largest provider (European Commission, 2018). By 2020 the operating capacity in Europe had fallen to 14.6 GW despite an extra 2.4 GW being added to the grid in 2020, due to the removal of UK wind farms from the reporting figures. By 2020 the sector was also now regarded as no longer emerging but a developed sector.

Offshore wind generation in the Irish Sea has been ongoing for some time, with the first wind farm (7 turbines) at Arklow Bank being constructed in 2004 with an operating capacity of 25.2MW (SSE Energy, 2021). Since then the number of wind farms in the Irish Sea has grown steadily but no further development has occurred in Irish waters yet to date. Recent offshore wind development in the Irish Sea has centred off the coasts of North West England and Wales. Large scale projects in English and Welsh waters have been constructed and are operational over the past 10 years. The largest is the Gwynt y Môr wind farm of the coast of North Wales, the fifth largest offshore wind farm in the world in 2016, with a generating capacity of 576 MW by 160 turbines. The Walney wind farms located off the Cumbrian coast in the North West of England, following an initial extension, became the largest offshore wind farm in the world in 2018, with a total of 189 turbines and an operating capacity of 1026.2 MW. A map of the locations of currently operational and planned offshore wind farms in the Irish Sea can be seen in Figure 9.

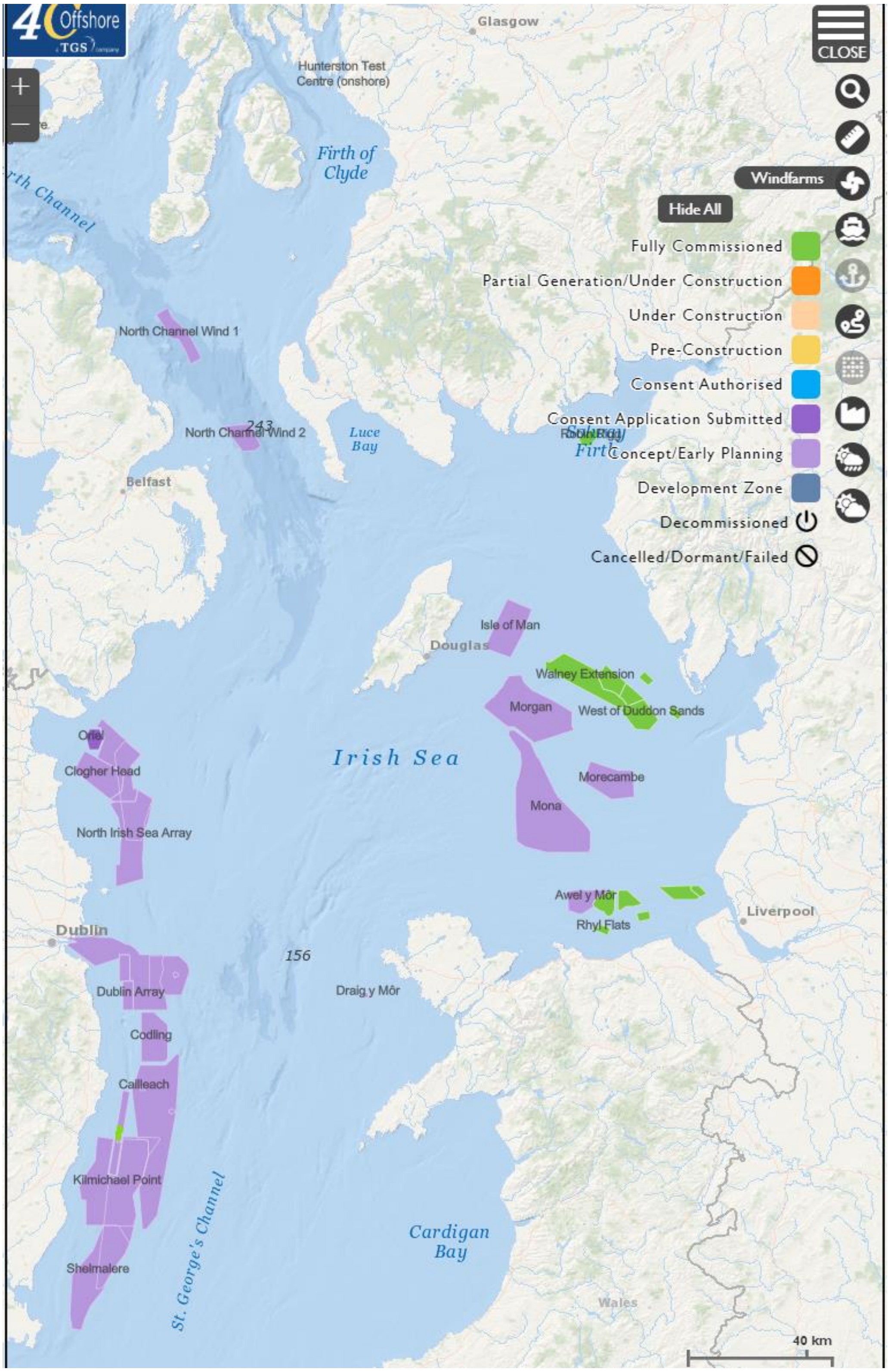


Figure 9: Existing and planned wind farms in the Irish Sea. Source: 4COffshore

No sites currently exist in Northern Irish waters due to serious objections to the visual impacts wind farms less than 13km from the shore would have on the coastline. The changing global climate and the increased need for national energy security may see a change in this stance in coming years. Whilst offshore wind farms themselves are not currently permitted in Northern Irish waters, the desire to provide a supporting industry remains a key part of future plans for the economy.

Despite limited progress in offshore wind farm development within Irish waters to date, ambitions for increasing offshore wind capacity in the Irish Sea are significant, with numerous sites under investigation. Table 2 shows the list of active (non-cancelled) wind farm sites currently proposed in the Irish waters of the Irish Sea.

As indicated in this table, only one fully commissioned wind farm exists at Arklow Bay 1, with a further project, Oriel off the coast of County Lough, which has submitted consent application. While the Oriel wind farm is much bigger in size and capacity than the Arklow Bay wind farm at 375 MW, even a combined output of both farms of around 400 MW, this is still a long way off the ambitious 5000 MW target by 2030.

4.2 Governance relating to offshore wind in the Irish Sea

The offshore wind energy industry in Ireland is driven by a number of key pieces of legislation and frameworks. The National Marine Planning Framework and the Marine Area Planning Bill 2021 is the most pertinent to this piece of work, and cites a number of key policies which are highlighted below to achieve both their broader marine strategies, and also those of the Climate Action Plan and the Climate Act 2021. The Offshore Renewable Energy Development Plan (OREDP) 2014 for Ireland identified the opportunity for the development of Ireland's offshore energy resources, including that of offshore wind.

The OREDP 2014 provides a framework for the sustainable development of Ireland's offshore renewable energy resources, with key objectives to boost the blue-green economy in Ireland, reduce greenhouse gas emissions, increase energy security and also create jobs within the green economy sector. The OREDP sets out the intentions of the government, in accordance with the 2013 Memorandum of Understanding between Ireland and the United Kingdom, to seek to enter into an Intergovernmental Agreement to facilitate the development of an export market in the UK when the sector is sufficiently developed. The OREDP also outlines a plan for job creation in the sector. The OREDP has subsequently been reviewed and the results of this review were published in 2018. The review highlighted the progress of the work undertaken to date, particularly in relation to a series of actions, relating to expansion of the sectors, expansion and development of infrastructure and development of export markets. Progress in trading electricity with the UK has stalled since the publication of the original report due to increasing legislative complexities, including Brexit. However, a feasibility study has been carried out via the Celtic Interconnector seeking to examine energy exchange between France and Ireland. The review also highlights progress made in developing a new planning and consent architecture for the marine environment which is covered under the NMPF and the Marine Area Planning Bill. A new plan, the ODERP II, will be published soon and will be an important planning tool as Ireland transitions to a plan-led regulatory regime for future development of offshore renewable energy underpinned by the NMPF.

Table 2. List of active offshore wind farm sites in Irish waters in the Irish Sea. Source: 4COffshore (2022).

Project Name	Owner	Owner Country	Capacity (MW)	Area km2	Status
Arklow bay - Phase 1	GE Energy	USA	25.2	4.76	Fully Commissioned
Codling	EDF Energy Nouvelles Group	France	1500	N/A	Concept/Early Planning
	Fred Olsen Renewables	Norway			
Oriel	Parkwind NV	Belgium	375	27.79	Consent Application Submitted
	ESB	Ireland			
Dublin Array	Saorgus Energy Ltd	Ireland	900	58.85	Concept/Early Planning
	RWE Renewables	Germany			
Arklow Bank - Phase 2	SSE Renewables	Scotland UK	800	64.74	Concept/Early Planning
North Irish Sea Array	Statkraft	Norway	500	226.97	Concept/Early Planning
Clogher Head	Parkwind NV	Belgium	500	123.72	Concept/Early Planning
	ESB	Ireland			
Kilmichael Point	ESB	Ireland	500		Concept/Early Planning
Cooley Point	Hibernian Wind Power	Ireland	500	156.6	Concept/Early Planning
SSE Renewables Braymore Point	SSE Renewables	Scotland UK	800	199.12	Concept/Early Planning
South Irish Sea	Energia Renewables	Ireland	1330	419.16	Concept/Early Planning
Shelmalere	DP Energy Ireland Ltd	Ireland	1000	299.34	Concept/Early Planning
	Iberdrola Renovables Energia S.A.	Spain			
Cailleach	Ocean Winds	Spain	1600		Concept/Early Planning
Greystones	COBRA INSTALACIONES Y SERVICIOS, S.A.	Spain	1000	143.04	Concept/Early Planning
Blackwater	COBRA INSTALACIONES Y SERVICIOS, S.A.		1500	429.08	Concept/Early Planning
Latitude 52	DP Energy Ireland Ltd	Ireland	1000	497.71	Concept/Early Planning
Sea Stacks	ESB	Ireland	800	302.99	Concept/Early Planning
TOTAL			14630.2	2953.87	

The Climate Action Plan and Climate Act 2021 set out Ireland's ambitious plans to move to a greener more sustainable economy. The key headline legally binding targets are the move towards net-zero greenhouse gas emissions no later than 2050, and a reduction of 51% by 2030. Offshore wind is not the only mechanism by which this may be achieved which is outlined within the plan, however the key target of 5 GW of electricity generation from offshore wind is a key action. One of the mechanisms to support the delivery of this target is by the investment in research and innovation. A new strategy is currently in development to outline these plans which will include the development of dedicated Enterprise Ireland (EI) technology centres and Science Foundation Ireland (SFI) research centres. In addition, the Sustainable Energy Authority of Ireland (SEAI) will provide public funding to invest in innovative research projects. The Renewable Electricity Support Scheme (RESS) will assist in the delivery of targets and work to ensure a steady pipeline of projects and use of the network. Addressing the lack of movement within the pipeline as indicated in Table 2 will be key to achieving production targets and progressing movement along the wind energy value chain. A cross departmental Offshore Renewable Energy Team is being established by the Department for the Environment, Climate and Communications (DECC) to support the development of the sector including identifying areas for infrastructure development.

The NMPF and Marine Area Planning Bill 2021 are key to the success of the Offshore Wind Energy in Ireland. In alignment with the other key documents and legislation mentioned previously the NMPF seeks to support the development of offshore renewable energy in Ireland in an efficient manner and where possible find synergies between this and other sectors which utilise the marine space. The initial focus for Offshore Renewable Energy policy (which also includes wave and tidal energy) will be the development of offshore wind farms in shallow waters, as this is an established and tested technology used across Europe and of course elsewhere in the Irish Sea in UK waters as shown in Figure 9. The NMPF lists 11 key planning policies which are summarised in Table 3.

The Maritime Area Planning Bill 2021 seeks to provide much needed reform to the planning system in the marine area. The bill will seek to enable many of the goals and targets listed within the Climate Action Plan and the OREDP (and subsequent OREDP II) largely by streamlining the consent process, moving from existing State and development consent regimes to a single consent principle with the introduction of single State consents known as Maritime Area Consents (MACs) involving a single environmental assessment. This reform is anticipated to be able to allow many of the projects listed in Table 2 to progress much more quickly. At present existing timelines for achieving planning permission for such projects can take up to 4 years, meaning commencement of construction of a wind farm is delayed significantly. The establishment of the Maritime Area Regulatory Authority (MARA) who will take over the functions of considering MAC applications and consider licencing applications within the marine area. At the time of writing, the MARA is currently being established with the aim to have the authority operational in 2022.

Table 3. Offshore Renewable Energy Policies within the National Marine Planning Framework for Ireland. Source: NMPF, 2021.

Offshore Renewable Energy Policy	Policy Description
ORE 1	Proposals that assist the State in meeting the Government's offshore renewable energy targets, including the target of achieving 5GW of capacity in offshore wind by 2030 and proposals that maximise the long-term shift from use of fossil fuels to renewable electricity energy, in line with decarbonisation targets, should be supported. All proposals will be rigorously assessed to ensure compliance with environmental standards and seek to minimise impacts on the marine environment, marine ecology and other maritime users.
ORE 2	Proposals must be consistent with national policy, including the Offshore Renewable Energy Development Plan (OREDP) and its successor. Relevant Projects designated pursuant to the Transition Protocol and those projects that can objectively enable delivery on the Government's 2030 targets will be prioritised for assessment under the new consenting regime. Into the future, areas designated for offshore energy development, under the Designated Marine Area Plan process set out in the Maritime Area Planning Bill, will underpin a plan-led approach to consenting (or development of our marine resources)
ORE 3	Any non-ORE proposals that are in or could affect sites held under a permission or that are subject to an ongoing permitting or consenting process for renewable energy generation (wind, wave or tidal should demonstrate that they will in order of preference: a) avoid, b) minimise, c) mitigate adverse impacts, or d) if it is not possible to mitigate significant adverse impacts, proposals should set out the reasons for proceeding. Applicants for non-ORE proposals in or affecting ORE sites should engage ORE developers in consultation during the pre-application processes as appropriate.
ORE 4	Decisions on ORE developments should be informed by consideration of space required for other activities of national importance described in the NMPF.
ORE 5	Proposals for activity that may adversely impact ORE test projects by virtue of being within or adjacent to ORE test sites, or between site and landfall of ORE test projects that may adversely impact ORE test site projects, should demonstrate that they will in order of preference: a) avoid, b) minimise, c) mitigate adverse impacts.
ORE 6	Proposals for infrastructure enabling local use of excess energy generated from emerging marine technologies (wave, tidal, floating wind) should be supported.
ORE 7	Where potential for ports to contribute to ORE is identified, plans and policies related to this port must encourage development in such a way as to facilitate ORE and related supply chain activity.
ORE 8	Proposals for ORE must demonstrate consideration of existing cables passing through or adjacent to areas for development, making sure ability to repair and carry out cable-related remedial work is not significantly compromised. This consideration should be included as part of statutory environmental assessments where such assessments are required.
ORE 9	A permission for ORE must be informed by inclusion of a visualisation assessment that supports conditions on any development in relation to design and layout. Where a development consent is applied for in an area already subject to permission, proposals must include a visualisation assessment to inform design and layout. Visualisation assessments should demonstrate consultation with communities that may be able to view the proposal, in addition to any other ORE development, which had received consent to proceed at a given site at the time the consent application is made, with the aim of minimising impact. Visualisation assessments will be informed by specific emerging guidelines (detailed in the actions set out in Annexes to this NMPF). Prior to specific guidelines being available, policy and best practice relating to visualisation assessment should be used. This consideration must be included as part of statutory environmental assessments where such assessment is required.
ORE 10	Opportunities for land-based, coastal infrastructure that is critical to and supports development of ORE should be prioritised in plans and policies, where possible.
ORE 11	Where appropriate, proposals that enable the provision of emerging renewable energy technologies and associated supply chains will be supported.

4.3 Adapting the value chain methodology

Using the general value chain for offshore wind as a starting point, and having reviewed the existing state of the offshore wind industry in Ireland as well as the framework conditions that support it, the value chain has been adapted to highlight areas of current activity. Due to the relatively early stage of many of the projects listed in table 2 and highlighted in Figure 9, major activity is presently focused around segments 2 and 3 as shown in Figure 10.

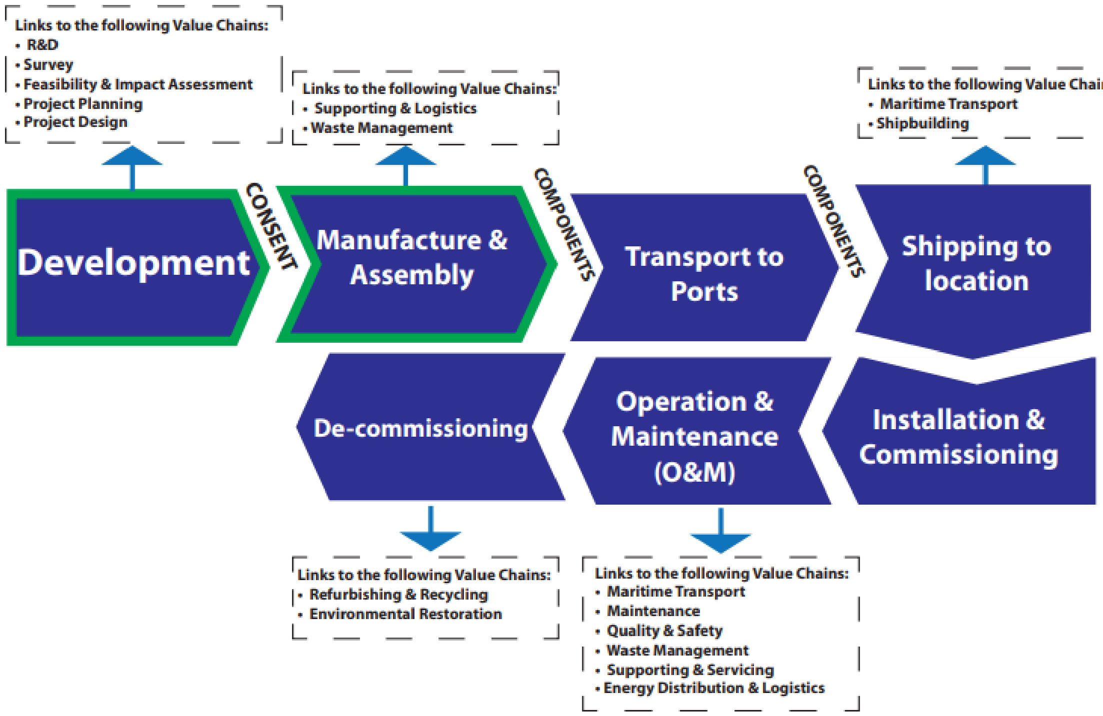


Figure 10: Tailored Offshore Wind Value Chain for Offshore Wind in the Irish waters of the Irish Sea Source: SIMAtlantic 2021 adapted from ESPON MSP-LSI 2019

In addition to the Development and Manufacture and Assembly segments, the links to other value chains also need to be given due consideration. Looking forward to construction of wind farms, planning for segments relating to transport and shipping will begin to become active parts of the value chain.

4.4 Case study results

The offshore wind industry in Ireland is at present still relatively underdeveloped in comparison with the UK's efforts in the East Irish Sea. Significant steps have been made over the past few years to streamline the consenting process which will hopefully allow a number of the projects identified to be brought online before the 2030 5GW target. While many of the proposed projects and investment are based within Ireland, much investment comes from elsewhere within the European Union and other third countries such as Norway and the UK. Figure 10 highlights the countries of origin of owner companies of the prospective wind farms identified against the proposed capacity of said wind farms.

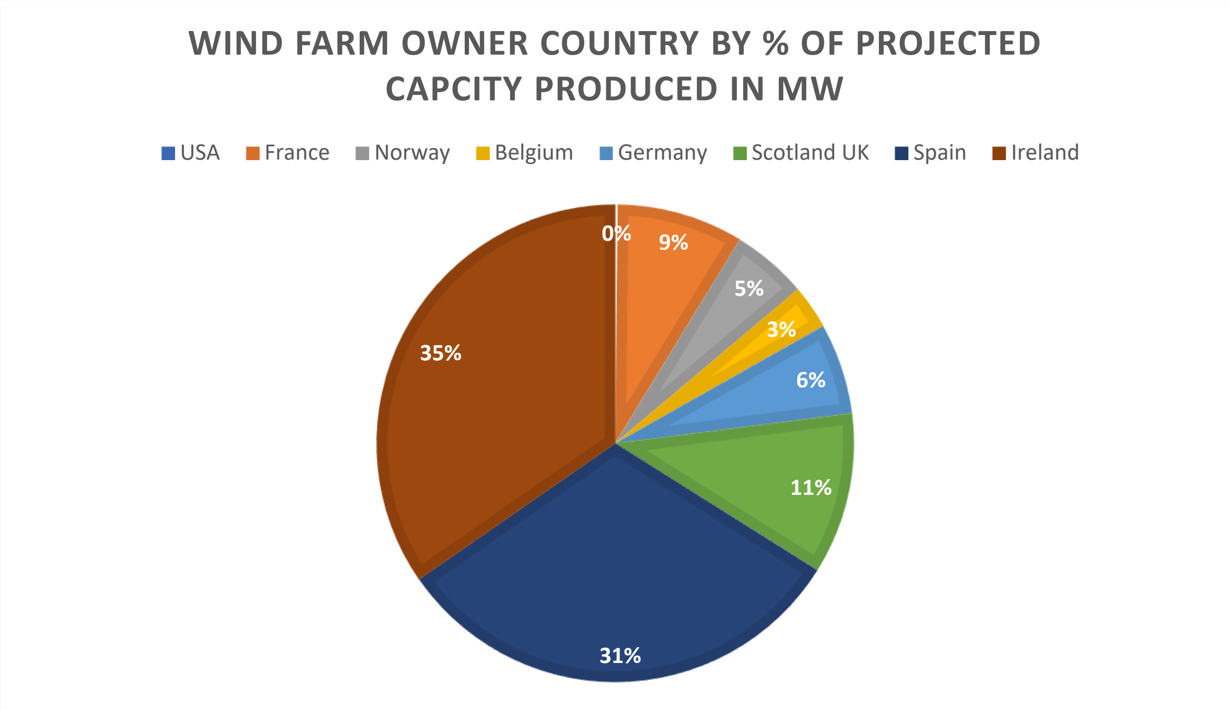


Figure 11. Country of origin of wind farm owner companies by proposed capacity in MW.

The significance of such figures for the Irish economy is that, in these developmental stages, many of the employment opportunities may well be outside of Ireland and Northern Ireland, particularly in relation to higher wage backet positions. The proposals set out, within the OERDP which relate to investment in R&D can seek to address any highly skilled workforce members being sought from outside of the project core area.

The policies outlined within the NMPF will, if acted upon in a timely fashion, assist growth and progression within the sector; however, there remains scepticism from certain stakeholders that these objectives can be achieved within the timeline outlined within the document itself.

The study has identified a number of barriers to growth of the sector and the steps which have been taken thus far to address them, including the upcoming introduction of the Maritime Area Regulatory Authority (MARA) and the single concept application process in the form of MACs.

4.5 Conclusions and future use of the tool

Value chain analysis is an appropriate tool for use in emerging markets and can provide guidance to authorities outlining where efforts should be focused in the future to aid progression. The potential for growth of the offshore wind energy industry in Ireland is huge and the potential economic benefits and those related to energy security particularly pertinent.

The steps that have been made to streamline the licensing process are to be commended; however, the delays in achieving all that has been suggested within Ireland’s Maritime Area Planning Bill and other legislation places uncertainty on delivering the legally binding targets which have been agreed upon. It would seem that these targets can be met by 2035, but the 2030 target seems unrealistic based on progress seen to date.

Access to full data, which requires significant financial outlay that was not available within the existing project budget, would be recommended, should a further value chain study be conducted.

5 Recommendations

The project has identified the following recommendations for action by marine planning authorities and other governmental departments which are specific for both the shellfish aquaculture industry and the offshore wind industry.

Table 4. Recommendations for the shellfish aquaculture and offshore wind industries. Source: SIMAtlantic Project 2021.

Recommendation Type	Recommendation
Planning	Zoning within MSP can assist licencing and other authorities when considering new sites for exploration. This will lead to the smaller scale preservation of certain areas important to other sectors or cultural/environmental protection.
Planning	On a regional or local level, effort must be sought to integrate the land and marine planning processes; where applicable, this should happen on a cross border level involving other relevant authorities, such as the Lough's Agency and industry representatives.
Legislation	Changes need to be made to react to the speed of a changing environment. Current legislation takes years, if not decades, to enact a meaningful change; this timeframe is too slow to address many of the consequences for industry which may arise. Legislation in this area needs to be adaptive.
Monitoring and Assessment	A cross border monitoring task force should be set in place, sharing data and resource to ensure expansion in one jurisdiction does not impact another.
Monitoring and Assessment	Many gaps exist within the data available, particularly in relation to land based pressures. Effort should be made by environmental authorities on both sides to address such issues.

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